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Science

U. S. Scientist Greeted by Eskimos

(See page 283)

Science

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(Cover photo by Laurence Irving.)

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Arctic Research Laboratory, Office of Naval Research, Point Barrow, Alaska

M. C. Shelesnyak, *Head*

Human Ecology Branch, Office of Naval Research

THE INCREASING INTEREST IN the Arctic has revealed an acute absence of any systematic body of scientific information about the basic biological and geophysical conditions of the region. The accumulation and synthesis of systematically collected data is very much needed. Observations during the past century have been gathered chiefly by the toil of individuals or small expeditions operating, in general, for short periods with limited technical and financial resources. Although many parties have gone into the field for seasonal studies, it has been apparent for years that long-term studies are essential to the understanding of Arctic phenomena. The establishment of fixed bases (field stations and laboratories) for the collection of regional data is of vital importance for carrying on Arctic research, particularly for studying the influence of physical and biological factors upon the function of man and machine. Advances in the technology of research which have been made during the past two or three decades are of a magnitude which demands greater financial support than can be managed without some public aid.

On August 13, 1946, the Office of Naval Research initiated an inquiry regarding the establishment, in the Arctic, of a basic scientific research laboratory where civilian scientists from universities could, under contract with the Navy, conduct investigations of biological and physical phenomena as related to that environment. The replies from various Navy organizations indicated a general enthusiasm and support for the idea of a laboratory for basic research in the Arctic.

In conformance with a general policy of the Office of Naval Research to seek counsel of qualified scientific investigators, well-known Arctic specialists, including Vilhjalmur Stefansson, Sir Hubert Wilkins, Dr. Laurence Gould, president of Carleton College, Dr. A. Lincoln Washburn, director of the Arctic Institute of North America, and Dr. Harald U. Sverdrup, director of Scripps Institution of Oceanography, were solicited for their opinions. All not only confirmed the need for such facilities but expressed a keen interest in the program and an enthusiastic appreciation of the Navy's assumption of aid and support of the work in this unexplored field.

It was envisioned that the initial program of any such organization would be focused on specific research projects rather than attempt to develop large physical plan facilities. A program for the pursuit of basic research in the Arctic was undertaken by contract between interested research groups and the Office of Naval Research (*Science,* August 22, 1947, pp. 164–165). The Director of Naval Petroleum Reserves and the Bureau of Yards and Docks of the Navy Department, which administers a contract for exploration of the Naval Petroleum Reserve No. 4 (including the Barrow area), cooperated in the support of the research teams.

In the article which follows, Laurence Irving has described some of the facilities now available to qualified scientists for carrying on basic research in the Arctic. Plans are under way for expansion of the program to include studies of a biological nature—ecological, physiological, mycological, and limnological—and of a geophysical nature—magnetic, auroral, meteorological, etc. Some problems in need of investigation have already been described (*1–3*), and new ones continue to appear as work progresses. It is believed that real opportunities exist in the Arctic for the scientist.

References

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Per F. Scholander, of the Department of Zoology, Swarthmore College, a member of the Point Barrow research team, is shown on this week's cover (*extreme right*) with three Chandler Lake natives who recall the Leffingwell, Stefansson, and Wilkins Expeditions to Arctic regions.

Arctic Research at Point Barrow, Alaska

Laurence Irving[1]
Swarthmore College

AS THE MOST NORTHERN PROJECTION of Alaska into the Arctic Sea, Point Barrow has been an important location for exploration of science and commerce in the American Arctic. From these explorations has arisen a rich literary record of expeditions for the examination of Arctic environments and life in Arctic regions. At present, Arctic resources of petroleum and information about weather, communications, and air travel through the area are of vital interest to us, and Point Barrow serves as an advanced base for these Arctic operations.

At this frontier point of practical scientific operations the Office of Naval Research has provided an establishment for pure scientific investigations. As a start, a scientific party of five from Swarthmore College and two from Cornell University arrived at Point Barrow on August 6, 1947, for a year's program of physiological research upon metabolism in Arctic climates. In mid-December it was possible to report briefly upon the work done. Inasmuch as laboratories for more extensive Arctic research are now in preparation, the experience of the first party may serve to guide future operations.

Physiological studies have determined the metabolic rate of about 8 air-breathing and aquatic, cold-blooded animals at various temperatures. The curves relating metabolism to temperature are similar to those of animals in temperate and tropical regions, but the Arctic curves are so placed as to show considerable metabolic activity at low temperatures, where tropical and temperate forms are inactive. In these curves is shown one aspect of the suitability of Arctic forms to their climate. Important inferences could be made from the results, but since the empirical relation of metabolism to temperature is not yet well determined for tropical forms, it would be better to await exposition of the natural contrast of metabolism in the tropics.

Measurements of the oxygen consumption and respiratory quotients of buds and roots of plants and of lichens show easily measurable amounts of metabolic activity of plant parts hitherto considered metabolically dormant in the Arctic winter. This activity in winter is enough to be significant to the natural metabolic economy. It is also measurable in ways which permit analytical study of the physiology and chemistry underlying the winter metabolism of Arctic plants. As in the case of animal metabolism, it is best not to project analytical studies until an examination of the tropical plant counterparts shows, over a broader natural range, the empirical relations between metabolism and temperature.

Measurements of the transfer of heat through the skin, fur, fat, and blubber of warm-blooded animals have been made upon a series of Arctic species—mountain sheep, caribou, reindeer, Arctic fox, Arctic least weasel, lemming, seal, ptarmigan, and snow bunting. The number of species of warm-blooded animals in the Arctic is so small that it is possible to survey them all and arrive at early conclusions as to the means used by animals for insulation against Arctic cold.

These few physiological studies outline Arctic problems of broad interest. The small number of species appears to facilitate obtaining conclusive results above broad biological lines. The few species can be well known. They are often the sole representatives of large taxonomic divisions, and their lives are dominated by the cold of the Arctic climate. Thus, natural conditions in the Arctic have eliminated the abundance of animal forms and environmental factors which in the tropics confuse the observer in his attempt to survey the relations between life and environment.

Other types of research appear especially appropriate to Point Barrow. Studies on the physiology of human acclimatization to cold will have for subjects native Eskimos, mechanics experienced in the Arctic and selected for that work, and comparative newcomers to the Arctic climate. The circulation in exposed faces and in hands and feet could be examined for vascular adjustments in the cold. Metabolism and nutrition of men in an Arctic construction camp provide for heavy work with varying amounts of exposure to cold. Certain native groups subsist mainly upon meat.

The numerous ponds, lakes, and rivers of the Arctic coastal plain show various stages of formation, drainage, and drying, with invasion by plant material and implicit association of animals. During the brief summer, growth is rapid—almost explosive, and sharp local temperature gradients develop at the surface of the ground and at the bottom of pools of water lying over black muck. Such conditions must operate to

[1] Scientific Director, Arctic Research Laboratory, Office of Naval Research, Point Barrow, Alaska.

select faunal and floral associations and sequences. The sudden emergence of plants and animals into summer activity which rapidly provides for growth and reproduction is a striking phenomenon.

Along the shore of the Arctic Ocean ice scrapes the sea bottom during many months, but that offshore beds yield rich fauna is shown by the animals cast up by occasional summer storms. Seals, walrus, whales, and polar bears are sufficiently numerous to indicate a considerable productivity of the Arctic Sea. Quantitative surveys of productivity and the life histories of these animals of the Arctic Sea and ice will be interesting when their pelagic phases are well known.

In the early summer great numbers of water and shore birds fly to the shores of the Arctic Sea, breed, and depart in a few months. Bird migrations are widespread, but in the Arctic the sudden arrival and departure of vast numbers is a striking event. Some species—the King Eiders, for example—follow narrow flight paths near the shore, and the concentration of their flights should be favorable for examination of the metabolism which supports their long and rapid migratory flights, as well as for investigation of the guidance which makes possible their navigation.

In referring to fields outside his own, a biologist is likely to see other sciences as aids, but it is obvious that all of the sciences are closely concerned with each other in the Arctic. The flat, rockless shores of the Arctic Sea are constantly forming bars and lagoons while being eroded by steady winds. The effects of ice are visible everywhere, and the sea ice is always near for investigation of the cyclic changes in salinity and finer and coarser structures which occur during seasons and even years. During most of the year a small snowfall drifts with rather steady winds, recording in the drifts the detailed occurrences at the air-snow interface which determine the characteristics of the snow cover. In the snow, men, animals, and plants obtain shelter where temperature and wind effects are moderated. Studies of the microclimates in snow promise interesting results in themselves as well as being necessary for defining the Arctic conditions of life and surface geology.

For 9 months of the year the ground surface is frozen. Frozen ground is always within a few feet of the surface, modifying the conditions of life no less than the progress of changes in surface geology. Subsurface masses of ice lie under mounds and cracks in the tundra. These are exposed in shore and valley cuts, indicating many peculiar localized influences of subsurface ice. The uneven tundra is a great record of superficial temperature changes which makes travel and construction difficult but which reveals the surface effects of frost in many scales of magnitude.

Although the ground is frozen hard for many months, the record of changes by seasonal frost from above and in the permafrost below is an impressive indication of the constant change in the surface of the Arctic plain through all seasons. Deeper effects of permafrost are being surveyed by physical methods and by drilling in connection with the exploration for petroleum, which lies in the sedimentary layers and occasionally seeps out to the surface.

The Office of Naval Research now has two laboratories at Point Barrow, each 40 by 100 feet, with the second floor of smaller area because of their hemispherical section. One is designated for the Natural Sciences, with rooms labeled for physiology, zoology, botany, limnology, oceanography, climatology, and geology to indicate, but not restrict, the range of subjects which can be profitably associated in describing the life and environment of the Arctic Plain.

The second building is designated for the Physical Sciences, and it will suffice for a biologist to remark that physical and chemical research on the ice, sea, earth, and atmosphere during the Arctic seasons is much needed to extend our knowledge of the earth. In these extreme but steadily changing conditions are experimental and observational backgrounds which can serve to extend the physical sciences.

These laboratories receive local maintenance and supplies from the Bureau of Yards and Docks through the Arctic Contractors, who operate the base camp. Lodging and food for personnel, common cold-weather clothing, local transportation, and native technical assistance are also provided through the Arctic Contractors. Judging from the experience of the group of physiologists, the support given to research is excellent. While not all facilities of an urban center are available, the speed, skill, and ingenuity shown by the local services excel that obtainable at home, for the personnel are selected by the Contractors and by conditions for ability to work rapidly and well in a situation where work is the main concern.

Although it is not proposed to stock the laboratories with instruments, certain basic laboratory equipment is accumulating. Equipment and clothing for field work, while in large part locally available, should be selected to suit needs of the field work in prospect.

Arrangements for research at the Arctic Research Laboratories are made by the Office of Naval Research, which may be expected to entertain proposals according to their practicability and for their contribution to the current of Arctic research. It is desirable to keep in view that the strongest individual programs will best fit practical conditions and aid in common progress.

Careful planning and preparation are essential for the successful outlook of an Arctic research program.

While there are cases in which valuable data may be obtained during a short visit, in general the cycle of the seasons must be observed to relate the subject of research truly to Arctic conditions. Freezing and thawing progress in long cycles, and ice and snow change rapidly under the influence of winter winds. While the summer is most spectacular superficially, there is more winter in the Arctic, and it cannot be known without the winter season.

The question may be raised as to whether it is now wise to establish a facility for research upon the extreme frontiers of civilization when routine teaching and regular research at home are short of personnel and facilities. Everywhere in the world today there is doubt as to the condition at these frontiers and fear of what may lie beyond them. Certainly, some of the men of science should be trying to explore and define accurately the frontier conditions under which man, in his ignorance, clashes with his environment and misguided social and economic forces have regularly led to war. Scientific exploration at the Arctic frontiers, where natural forces are strong and clear, can guide the domestic operations of science in lines leading realistically forward.

Arctic research in the past has greatly enriched our culture, and no similar extent of temperate or tropical coast line can list names and works of such distinction as those which have derived their information from exploration along the Arctic Coast of America. There may be a great literature based upon Soviet Arctic researches, but this we cannot know until all workers in Arctic research freely exchange views across the Arctic Sea.

NEWS and Notes

Lawrence E. Stout, professor of chemical engineering, Washington University, has been appointed dean of the School of Engineering. Dr. Stout's appointment will be effective July 1, when **A. S. Langsdorf** retires.

Reidar F. Sognnaes, recent winner of a Norwegian dental prize for his contribution toward the understanding of the reduction in dental decay which occurred in Norway during the war, was recently named associate professor of dental medicine in the Harvard School of Dental Medicine.

William F. Hewitt, Jr., formerly of the Research Division, Smith, Kline & French Laboratories, has been appointed assistant professor of physiology in the School of Medicine, Howard University.

Jack Purdue, associate professor, will become chairman of the Department of Chemistry, Oklahoma Baptist University, Shawnee, effective in September.

Robert A. Dreyer, associate professor of geology, University of Kansas, has recently been appointed chairman of the Department, to succeed **L. R. Laudon**, who will go to the University of Wisconsin after the spring semester.

Joshua Lederberg, formerly a research fellow at Yale University, has become assistant professor of genetics at the University of Wisconsin, where he is organizing a program in the genetics of bacteria and other microorganisms.

B. F. Skinner, of Indiana University, has been elected professor of psychology at Harvard University. Beginning in September 1948, he will offer a course in general education on Human Behavior and continue his researches on the behavior of organisms in the new Harvard Psychological Laboratories.

William A. Dreyer, University of Cincinnati, **Sherman C. Bishop**, University of Rochester, and **William M. Ingram**, Mills College, California, have been appointed to research fellowships at the Edmund Niles Huyck Ecological Research Station at Rensselaerville, New York, for the summer of 1948.

Jesse P. Perry, Jr., who was recently graduated from the Duke University School of Forestry, has been appointed instructor in forestry at Virginia Polytechnic Institute, Blacksburg.

Thomas B. Niven, formerly head of the biochemistry section of Economics Laboratory, Inc., St. Paul, has joined the staff of the Food Technology Department, Oregon State College, Corvallis.

Grants and Awards

The American Academy of Arts and Sciences announces availability of grants for chemical research from the Cyrus M. Warren Fund. The grants cover expenditures for apparatus, supplies, or for the construction of special facilities for research in chemistry or in closely allied fields but do not cover salaries. The amount available to an individual is seldom in excess of $300. Applications must be filed prior to May 1, 1948. Application blanks may be obtained from the Chairman, Frederick G. Keyes, Massachusetts Institute of Technology, Cambridge 39, Massachusetts.

The Louis Livingston Seaman Fund of the New York Academy of Medicine has available $1,200 for furtherance of research in bacteriology and sanitary science during 1948. Provided by the will of the late Dr. Seaman, the funds may be used for securing of technical help, aid in pub-

lishing original work, or purchase of necessary books or apparatus. Applications from either institutions or individuals will be received by Dr. Wilson G. Smillie, Chairman of the Louis Livingston Seaman Fund, 1300 York Avenue, New York 21, New York, up to April 15, 1948.

The Department of Bacteriology, University of Maryland, has received $4,107 from the U. S. Public Health Service in renewal of a grant for a study under the direction of Michael J. Pelczar on the metabolism of saprophytic *Neisseria*, with particular emphasis on their nutritional requirements.

L. H. Schmidt, Christ Hospital Institute of Medical Research, Cincinnati, has recently received funds from the Cinchona Products Institute, New York, for detailed studies on antimalarial activities of various dosage regimes of quinine, administered either alone or in combination with pentaquine and other 8-amino-quinolines.

The Board of Managers of The Jane Coffin Childs Memorial Fund for Medical Research has recently authorized a number of grants for varying periods of time. Recipients of the grants and their projects follow:

Francisco Duran-Reynals, Yale University School of Medicine, relation of viruses to tumors, $2,000.

Administration, Yale University School of Medicine, maintenance of animal house at 11 Rose Street, $700.

Cornelius P. Rhoads, Memorial Hospital, chemical and metabolic studies of cancer in man and animals with special reference to steroids, $30,000.

The Donner Foundation, continued support of the journal, *Cancer Research*, $5,500.

Harry S. N. Greene, Yale University School of Medicine, biological behavior of human and animal tumors in natural and alien hosts, including immunochemical investigations of adult, embryonic, and cancer tissues, $36,000.

Charles W. Hooker, Yale University School of Medicine, experimental and spontaneous testicular tumors in mice and other animals, $9,200.

Alexander Haddow and associates, Chester Beatty Research Institute of the Royal Cancer Hospital (Free), London, England, investigations on cancer with special reference to the chemistry of carcinogenesis, viruses, and chemotherapy of cancer, $5,000.

Janet Howell Clark, University of Rochester, effects of light radiations and other factors on the development of mammary tumors and leukemia in mice, $4,100.

Millislav Demerec, Long Island Biological Association, Cold Spring Harbor, mutagenic potencies of carcinogens and related chemicals as determined with bacteria, $8,000.

Sir Ernest L. Kennaway, St. Bartholomew's Hospital, London, England, statistical and laboratory studies of cancer, $1,500.

Cornell University Medical College, development, training activities, and investigations of the Tumor Clinic, $12,000.

In addition, the following fellowships were awarded:

Carl G. Baker, University of California, study of the specific accumulation of compounds in neoplasms with the aid of radioactive isotopes, $4,958.34.

John B. Goetsch, Yale University School of Medicine, malignancy and autonomy of tumors of the human genitourinary system studied by heterologous transplantation, $4,000.

Donald D. Mark, The Rockefeller Institute for Medical Research, precancerous lesions that precede the development of tumors in the liver, intestine, and skin, $7,125.

John J. Trentin, Yale University School of Medicine, hormonal factors influencing mammary gland growth and development, $5,133.33.

Alexander Symeonides, National Cancer Institute, $1,400.

Richard B. Krakaur, The Rockefeller Institute for Medical Research, study of enzyme systems of cells, $3,000.

Graduates of Chicago medical schools who completed their internship or one year of laboratory work in 1946 or thereafter are eligible to compete for the Joseph A. Capps Prize of $400 of the Institute of Medicine of Chicago. The Prize, which was founded by Dr. and Mrs. Edwin R. LeCount, will be given for meritorious investigation in medicine or in the specialties of medicine. Work in the fundamental sciences will be considered, provided it has a definite bearing on some medical problem. Manuscripts should be submitted to the Secretary of the Institute of Medicine of Chicago, 86 East Randolph Street, Chicago 1, not later than December 31, 1948. The winning manuscript will become the property of the Institute.

The John and Mary R. Markle Foundation has made public its first group of Scholars in Medical Science. For the support of the qualified young scientists who wish to make a career in academic medicine and their research, the Foundation has allocated $400,000 to their respective medical schools, each school to receive $25,000 payable at the rate of $5,000 annually for 5 years. The 16 Scholars and the medical colleges nominating them are: Christian B. Anfinsen, Harvard Medical School; Henry H. Balch, New York University College of Medicine; Edward J. Beattie, Jr., George Washington University School of Medicine; Marcel E. Blanchaer, University of Manitoba; Ivan W. Brown, Jr., Duke University School of Medicine; Robert H. Ebert, Division of Biological Sciences, University of Chicago; Richard C. Fowler, University of Rochester School of Medicine and Dentistry; Henry D. Hoberman, Yale University School of Medicine; Ralph A. Kinsella, Jr., St. Louis University School of Medicine; Christian J. Lambertsen, University of Pennsylvania School of Medicine; William D. Lotspeich, Syracuse University College of Medicine; Preston B. Lowrance, University of Virginia Department of Medicine; Frederick D. McCandless, Albany Medical College; Manson Meads, Bowman Gray School of Medicine; Julius B. Richmond, University of Illinois College of Medicine; and Ralph O. Smith, Washington University School of Medicine.

The American Telephone and Telegraph Company recently announced the 9 winners of the 1948–49 Frank B. Jewett fellowships for research in the physical sciences. The

awards grant $3,000 to the recipient and $1,500 to the institution at which he chooses to do his research. Those receiving the 1948–49 postdoctoral fellowships are: Warren John Brehm, James Allister Jenkins, Robert Karplus, and Richard Nelson Thomas, all of Harvard University; Ernest Max Grunwald, Portland Cement Association, Chicago; Leon Albert Henkin, Princeton University; Alvin Ira Kosak, Ohio State University; Joaquin M. Luttinger, Physikalisches Institut, Zurich; and Paul Olum, Institute for Advanced Study.

Colleges and Universities

The schedule for the series of lectures on statistical methods by L. H. C. Tippett to be given at Massachusetts Institute of Technology this spring (see *Science*, March 5, p. 242) has been revised as follows: "Statistical Methods for Industrial Quality Control," May 5–7, 3–5 P.M.; and "Statistical Methods for Technical Investigation and Experimentation," May 12–14, 3–5 P.M.

The College of Engineering, University of Illinois, has announced that 9 new options are available to mechanical engineering students: production engineering, design, power, research, aeronautical, air-conditioning and refrigeration, petroleum production, railway, and general. In production engineering four new courses are now operating—motion and time study, production engineering, tool engineering, and production control. Related courses include industrial quality control, industrial relations, and labor relations. Instructors for the courses are C. H. Casberg, John Henry, L. C. Pigage, and Everett Laitala. Graduate courses are being formulated.

Harvard's new synchro-cyclotron will probably be ready for a test run toward the end of this year, according to an article which recently appeared in the *Alumni Bulletin*. The article points out that the 95″ machine, which is the same size as that being built at the Atomic Energy Research Establishment at Harwell, England, has been designed with several points in mind, including its suitability for the 30 or so members of the cyclotronic staff and its effective coverage of an energy region not covered with facility by the larger cyclotrons now in use in this country. Harvard's first cyclotron, a 42″ machine, was turned over to the Manhattan District, U. S. Army Engineers, in 1943.

The Chemistry Alumni Association of the City College of New York has announced that Irving Langmuir, Nobel Prize winner and associate director of research, General Electric Company, will give the inaugural address of its Bicentennial Science Lectures on April 23 in the Great Hall of the College. His subject will be "Science and Common Sense: Convergent and Divergent Phenomena." Admission is free, but tickets should be obtained in advance from the Department of Chemistry, The City College, 140th Street & Convent Avenue, New York 31.

The lectures of the Herter Foundation for 1948 will be given by Ernest F. Gale, Medical Research Council Unit for Chemical Microbiology, Biochemical Laboratory, Cambridge, England, at the Hurd Memorial Hall, The Johns Hopkins Hospital, Baltimore, March 22–24.

Summer Programs

The Department of Physics, University of Wisconsin, has announced that E. P. Wigner will join the staff as a visiting professor for the 1948 summer session (June 25–August 20). A seminar in theoretical physics will be held in addition to classes in thermodynamics, statistical mechanics, and nuclear physics.

The Summer School of Alcohol Studies conducted by the Laboratory of Applied Physiology, Yale University, will hold its 6th annual session July 9–August 6. The curriculum deals with the medical, psychological, psychiatric, sociological, economic, legal, religious, educational, and therapeutic aspects of alcohol problems. The 1948 course provides a special curriculum for physicians and other students professionally concerned with the treatment and care of alcoholics, including work at the Yale Plan Clinic in New Haven.

The School, under the directorship of E. M. Jellinek, will have as lecturers authorities who have carried out original research in their respective fields. The lecturers, mainly from the faculties of Yale, include representatives of other national institutions of education, research, treatment, or rehabilitation.

Applications for admission and scholarships will be received up to April 15. A prospectus and application may be obtained by writing to the Executive Secretary, Summer School of Alcohol Studies, Yale University, 52 Hillhouse Avenue, New Haven, Connecticut.

The Oceanographic Laboratories of the University of Washington at Friday Harbor have reported that their summer staff will include Alfred C. Redfield, associate director of the Woods Hole Oceanographic Institution, who has been named Walker-Ames professor at the Laboratories, and Robert C. Miller, director of the California Academy of Sciences.

Meetings and Elections

The Association of Geology Teachers will hold its 8th annual meeting April 9–10 at Hanover College, Hanover, Indiana. Those wishing to attend should notify the president, Arthur L. Howland, Department of Geology, Northwestern University, Evanston, Illinois.

The American College of Physicians has completed arrangements for its 29th annual session to be held in San Francisco, California, April 19–23. The 5-day meeting will include general sessions, lectures, clinic sessions at local hospitals, panel discussions, and demonstration tours with additional arrangements for sightseeing tours. Hotel accommodations have been facilitated and special trains, with postconvention tours to points of interest in the West, have been arranged. Copies of the final bulletin may be had by writing to the ACP Executive Offices, 4200 Pine Street, Philadelphia 4, Pennsylvania.

The annual meeting of the Society of American Bacteriologists will be held in Minneapolis, Minnesota, May 10 through 14, with headquarters at the Nicollet Hotel. There will be sessions on general agriculture, industrial and medical bacteriology, as well as immunology and comparative pathology.

The Society for Applied Spectroscopy, in cooperation with the Polytechnic Institute of Brooklyn, announces a Symposium on Spectroscopic Equipment, to be held May 22 at the Polytechnic Institute, 85–99 Livingston Street, Brooklyn 2, New York, under the chairmanship of W. L. Parker. Recent developments on instruments in the field of absorption and emission spectroscopy will be exhibited.

The Dallas Southern Clinical Society elected the following officers at a recent meeting: H. Walton Cochran, president; Frank A. Selecman, vice-president; Lawrence B. Sheldon, secretary; and Andrew B. Small, treasurer. The new officers are all clinical faculty members at Southwestern Medical College.

The 44th annual meeting of the American Society of Zoologists was held in Chicago December 29–31 in conjunction with Section F (AAAS) and in association with a number of other biological societies. Of special significance, according to L. V. Domm, of the University of Chicago, secretary of the Society, were (1) the excellent quality of the symposia, (2) the large number of general papers presented, and (3) the large general attendance.

Two symposia were arranged. One, under the leadership of T. M. Sonneborn, was held jointly with the Genetics Society of America. Dr. Domm reports that the 7 participants presented an unusually well-integrated and coordinated account of recent work on plasmagenes, genes, and characters in *Paramecium aurelia* (estimated attendance, 600–700 persons). The other symposium, organized by J. L. Lush and also sponsored jointly with the Genetics Society, dealt with a review of methods for the genetic improvement of farm animals. Between 400 and 500 persons heard the 5 participants give a critical account of possibilities in artificial insemination, ways in which more exact knowledge of genes and linkage relations can be used, possibilities of mass selection, usefulness of family selection and inbreeding, and actual possibilities in progeny testing.

The annual dinner of the Society on the evening of December 30 in the Crystal Ballroom of the Blackstone Hotel was attended by 148 persons. Because of the illness of Franz Schrader, his address on "Three Quarter-Centuries of Cytology" (*Science*, February 13, p. 155) was read by C. L. Huskins, professor of botany at the University of Wisconsin.

At the annual business meeting on December 30 the Society elected Carl G. Hartman, Ortho Research Foundation, president; T. C. Nelson, Rutgers University, vice-president; Frank A. Brown, Jr., Northwestern University, treasurer; and J. H. Bodine, State University of Iowa, member of the Executive Committee. L. V. Domm continues as secretary.

Letter From London

From time to time *Science* has published notes about the Mission on Science and Technology to the U. S. Embassy in London. Prior to the departure of the Mission, arrangements were made whereby a "Letter From London" would be forwarded for publication in *Science* at intervals of approximately two weeks. Although the staff is still far from complete, several specialists are already at work, and the first letter appears below. The regular schedule of two weeks will probably be followed as soon as the staff is complete; until such time, the letters will be published promptly on receipt.

Scientists, industrialists, and labor leaders have manifested considerable interest in the formation of a Committee on Industrial Productivity, announced by the Lord President of the Council, Mr. Herbert Morrison, in the House of Commons on December 18, 1947. The new Committee, which is ultimately responsible to Mr. Morrison, is for this reason put on the same level as the Advisory Council on Scientific Policy and the Defense Research Policy Committee. The earlier organizations are concerned with the development of new knowledge, but the establishment of the new Committee signified that the present government is equally concerned about the prompt and widespread application of science and technology.

Sir Henry Tizard, who acts as chairman of the earlier organizations, will also be the chairman of the Committee on Industrial Productivity. The person responsible for policy with regard to the development of new knowledge will also be charged with recommending means for its most efficient use. This fact alone warrants the closest attention being paid to the future accomplishments of the new Committee.

The concern of the Committee on Industrial Productivity will, as its name suggests, be primarily in the application of existing scientific and technological knowledge to industry, agriculture, and health. The social and psychological factors which accelerate or impede the introduction of new scientific knowledge are also to be studied in the light of current and future knowledge in the social sciences about this subject. Stated formally, the terms of reference of the Committee are:

"To advise the Lord President of the Council and the Chancellor of the Exchequer on the form and scale of research effort in the natural and social sciences, which will best assist an early increase in industrial productivity, and further to advise on the manner in which the results of such research can best be applied."

The extremely wide frame of reference of the Committee, comprehending, as it does, an examination of all factors which assist in an increase of national productivity, is somewhat narrowed when attention is paid to the panels which are to be established by the Committee.

One panel, under the chairmanship of Sir William Stanier, F.R.S., will be concerned with technological and operational research. Operational research, as used in Great Britain, has come to mean an attempt to provide executive or administrative officers with a quantitative estimate of their operational variables by use of the scientific method.

A second panel, under the chairmanship of S. Zuckerman, C.B.F.R.S., professor of anatomy at Birmingham,

will deal with the question of import substitution. This group will presumably develop their work in the light of the current international shortages in hard currency and undertake to suggest better means of using local and colonial raw materials and substitutes for traditional British imports. It is of some importance that both scientists and economists are represented on this panel.

A third panel, under the chairmanship of Sir George Schuster, K.C.S.I., K.C.M.G., C.B.E., M.E., will deal with the human factor affecting industrial productivity. This group will presumably investigate the causes of dissatisfaction among workers, the prospect for increasing individual output, the views of the worker and his organization on the introduction of the new technical developments.

Finally, Dr. Alexander King, director of the Scientific Secretariat of the Lord President's Office, will head a panel on technical information service. This group will recommend means for the more rapid dissemination of scientific knowledge with a view to its introduction into industry, agriculture, and other phases of the nation's production.

The Committee will operate in close cooperation with the Advisory Council on Scientific Policy because of Sir Henry Tizard's connection with both bodies. The Committee, as currently constituted, will be made up of representatives from government and university science, government departments, industry, and labor.

NRC News

From December 1945 to December 1946 a committee of the Division of Geology and Geography sponsored several conferences devoted to problems of training in geology. Participants from educational and research institutions throughout the country engaged in lively and spontaneous discussion which reflected wide recognition of a need to improve geological curricula. Complete records of the conferences, and also a final report of the committee, have been published in the *Interim Proceedings of the Geological Society of America* (Parts 2, 4, and 5 of 1946, Parts 1 and 3 of 1947).

At the fourth of the conferences there was considerable support for a proposal that the Division of Geology and Geography be asked to publish, through a medium with wide circulation, a recommended list of courses prerequisite to graduate study in geology. In its final report the committee expressed the view that basic training for undergraduate students who intend to make geologic work their profession should include courses in mathematics, physics, chemistry, and biology, and in modern foreign languages. Through an oversight, the report did not ask that the Division arrange for wide publication of these views regarding preparation for graduate study. The present note is offered as a brief explanatory digest of the views expressed in the conference, in the hope that teachers of geology may be helped in their efforts to make the curriculum more effective.

The group responsible for the present statement has no desire, nor has it any commission, to set up "rules for accreditation" in geology. However, there is clear need for better teamwork than now exists in preparing students of geology for advanced study and for professional work. Graduate departments find that many of the applicants for admission are woefully deficient in basic preparation. Some applicants whose college transcripts show completion of numerous geologic courses lack the most elementary acquaintance with physics, chemistry, mathematics, and biology. We, and many others who took part in the conferences, are firmly convinced that the elements of these subjects are essential in any rounded education and are mandatory in geologic training. Elementary courses in the four allied subjects should be completed as early as possible in undergraduate years, in order that they may integrate most effectively with basic courses in geology. Too commonly, the allied subjects are treated as hurdles that may be taken at any stage in the educational program. Many principles of physical geology can be grasped only through some knowledge of physics and chemistry. Paleontology must, of course, build on a foundation of biology. An effective program of geologic training must put fundamental things first.

The present brief statement cannot undertake to make and explain specific recommendations for a complete undergraduate curriculum in geology. It is our conviction, however, that every program should include elementary courses in physics, chemistry, biology, and mathematics through calculus. There will be objection that one or another of these subjects is not essential for students interested in particular fields of geology. An effective answer to this objection rests on the sad experience of many students whose interests changed as they advanced, and especially of those who later found that their ignorance of a basic subject was a serious disqualification for attractive professional opportunities. After a broad foundation is laid, thought should be given to additional courses in auxiliary sciences that will aid in preparation for particular fields of geology. A second course in physics and a course in physical chemistry are urged for students who decide at an early stage to equip themselves for some aspect of physical geology. Those who elect paleontology will find it profitable to take one or two additional courses in biology before they begin graduate study.

Graduate departments have perennial trouble with students who are unprepared to meet requirements in foreign languages. If these requirements are to have any real value, students must master the languages in time to make them useful tools in advanced geologic study. Only an exceptional student can learn a language after he plunges into exacting graduate work. Basic training in languages should come in undergraduate years. It would be far better to defer some of the geologic courses commonly taken by undergraduates, in order to lay a sound foundation in the languages which ought to be ready for use at the very start of graduate study.

German has long been, and still is, the foreign language most valuable as a key to general literature in geology. French, the traditional second language for the graduate student, has a growing rival—Russian. There is not an abundance of first-class geologic literature in Spanish. Geologists who work in Mexico and other Latin-American countries must, of course, be able

to use Spanish, not only for practical everyday needs but also for a command of the local geologic literature. However, students in geology rarely can foresee that Spanish will serve their purpose better than another foreign language. It is recommended, therefore, that in general the languages for the geologic curriculum be German and either French or Russian.

Some of the continuing difficulties in these matters stem from the fact that many students decide at a late stage to prepare for professional work in geology. It would, of course, be simpler for all concerned if every student could assuredly map his complete program of study at the start of the freshman year. We cannot expect to attain this ideal and must be prepared to face difficulties from late decisions. However, we should not make compromises that destroy all standards. A student should be required to spend additional terms in undergraduate study rather than be permitted to enter a graduate department without basic preparation.

In the attempt to maintain creditable standards of preparation, small departments in "liberal arts" colleges may appear to be at a disadvantage because of limited teaching staffs. It has been pointed out, however, that some of these small departments have enviable records in supplying outstanding candidates for advanced study. A wise teacher in such a department can find in his apparent weakness a source of strength. Unable to offer numerous courses in his own subject, he can direct his students to essential courses in allied sciences and in foreign languages, thus enabling them to acquire keen-edged tools for their further progress. It has been pointed out that a student must have some continuous contact with geology if his enthusiastic interest is to be maintained. This is, of course, correct. A proper balance of diet is required, and geology must be the essential ingredient of the menu. Too often a lack of balance is the result of too many geologic dishes which the undergraduate is ill prepared to digest.

Members of the committee do not wish to give the appearance of belaboring unduly any particular theme. From our survey thus far, however, we believe that a fundamental weakness in our training arises from a common failure to require of undergraduates early attention to basic subjects. Exceptional students are able to overcome the handicap of a defective curriculum. Wise repairing of the curriculum will help both the exceptional and the more ordinary students and will advance the development of geologic science. (COMMITTEE ON GEOLOGIC EDUCATION—*Chester R. Longwell* (chairman), *Robert Balk, David M. Delo, Maurice Ewing, M. King Hubbert, Hugh E. McKinstry, A. I. Levorsen, George A. Thiel, A. O. Woodford.*)

Deaths

K. F. Chamberlain, 54, assistant state entomologist, New York State Museum, died December 4. His particular interest had been the study of aquatic beetles.

N. H. Darton, 82, consulting geologist since his retirement from the U. S. Geological Survey in 1936, died February 28 in Chevy Chase, Maryland.

Ernest G. Maier, 68, assistant professor of gynecology, University of Pennsylvania Graduate School, died March 5 in Philadelphia.

George Edward Gage, 64, head of the Department of Physiology, University of Massachusetts, and a member of its faculty for 37 years, died suddenly March 7 in Amherst, Massachusetts, following a heart attack.

Reid Hunt, 77, pharmacologist and professor emeritus at Harvard Medical School, died March 10 in Boston. Dr. Hunt is known for his work on the thyroid gland and the discovery of chemical mediation of nervous impulses through the use of acetylcholine.

Eugene E. Gill, 72, formerly associate professor of chemistry, Armour Institute of Technology, died March 10 in Denver, Colorado.

Since announcement of the foreign distribution program of radioisotopes late last summer by the Atomic Energy Commission, 44 shipments have been made to individuals and research groups in Australia, Argentina, the United Kingdom, Denmark, Peru, Canada, Italy, and Sweden, while 8 other countries have completed the necessary arrangements for receiving shipments. Meantime, U. S. investigators have received approximately 1,000 shipments, bringing the total of shipments under the domestic distribution program to 2,200. Topping the list of exported isotopes is radiophosphorus, used mainly in medical therapy for treatment of serious blood diseases. When the full 6-month investigative period has been completed in each foreign country, progress reports will be submitted to AEC.

Simultaneously with the announcement concerning progress of the foreign isotope distribution program, AEC and Columbia University announced plans for public distribution and sale of the first two volumes of the Manhattan Project Technical Section of the National Nuclear Energy Series, to be published by McGraw-Hill under contract with Columbia. The series wil consist of a compilation of unclassified or declassified research reports on work begun during the war and now carried on as part of the U. S. atomic energy program. The first two volumes will deal with contributions to medical science, Volume 1 dealing with the histopathological effects of radiation, and Volume 2 with the pharmacology and toxicology of uranium and fluorine compounds. It is expected that about 60 such volumes will be made available over the next two years.

Make Plans for—

American Association of Physical Anthropologists, April 2–4, U. S. National Museum, Washington, D. C.

American Mathematical Society, April 16–17, New York City and Ann Arbor, Michigan; April 17, Berkeley, California.

★ ★

AAAS
Centennial Celebration
Washington, D. C.
September 13–17, 1948

★ ★

Comments and Communications

On the Use of Cellulose in Diets

Recent comments by F. Hoelzel and A. J. Carlson (*Science*, December 19, 1947, pp. 616–617) on the practice of adding cellulose to experimental diets at the expense of glucose included remarks pertaining to a paper by us on the growth-promoting action of cellulose in purified diets for chicks (*J. Nutrition*, 1947, 34, 295).

With respect to our paper, we wish to present the following points which Hoelzel and Carlson apparently overlooked:

(1) "Ruffex," a roughage material derived from rice hulls and containing 70% alpha cellulose, was used exclusively in our experiments rather than "Cellu Flour," which is obtained from purified and bleached wood pulp, straw pulp, or cotton fiber (*Conn. agric. exp. Sta. Bull. 127*, 1921, p. 230). The source of cellulose may be a consideration, as preliminary experiments with cotton flock supplemented at the expense of glucose did not give statistically significant increments of growth when compared with chick control groups.

(2) Since the greatest growth response was obtained with just 5% of cellulose rather than with the higher levels, it is hardly conceivable that the results we obtained were due to the very slight increase in the proportion of protein, minerals, fat, or vitamins to the glucose portion of the diet. Ample levels of protein, fat, minerals, and vitamins for the chick were present in the basal ration. Our evidence, in addition, did show that at least part of the cellulose was utilized by the chick.

(3) As Hoelzel and Carlson pointed out, and as is very obvious, the available carbohydrate portion of the ration is reduced when cellulose is fed at the expense of glucose. We were aware of this important consideration and pointed out in our discussion (p. 299) that the "retarded growth and lowered feed efficiency values with the feeding of the 20 percent through 50 percent levels of cellulose were probably caused by a decrease in the availability of metabolizable simple carbohydrates, since the supplements were fed at the expense of glucose." The excellent feed efficiency values obtained with the diets containing the lower levels of cellulose indicate that sufficient utilizable carbohydrate was available (all diets were fed *ad libitum*) in these cases.

(4) That there is also a very real disadvantage in adding cellulose to the complete ration (not at the expense of any nutrient), especially in studying the higher levels, is pointed out by a recent paper by E. F. Adolph (*Amer. J. Physiol.*, 1947, 151, 110). He reported that rats, fed diets in which cellulose and other forms of bulk were added to a complete diet, ingested more bulk but stopped before they ingested a full quota of nutrients. "The limited ability to handle roughage in the alimentary tract then became a factor in the animal's urges to eat."

We feel that the interpretations of the results we obtained were justified from the data given, and that the growth-promoting action of cellulose ("Ruffex"), or its decomposition products, which we obtained with chicks was due to other reasons than the very slightly altered proportion of nutrients in the diet.

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University of Minnesota

On Literature Citation

The desirability of references to scientific literature in a published article is not under dispute. There are differences of opinion, however, as to how these should be cited to be of benefit to the reader.

There are three main objects in citing references: (1) to give credit to the original author of a method, theory, process, or other innovation; (2) to tell the reader where to find more information on the subject under discussion; (3) to define the basis of published works on which inferences are drawn. The first of these objects is fully accomplished by citing the author and the location of the original work in scientific literature.

The achievement of the second object depends on circumstances. If the author wants to lead the reader to broader treatment of the point under discussion, he has before him the choice of referring to the abstract which he consulted and found helpful or of citing the original publication, which he may or may not have consulted. Unless the original was studied and is easily available, the reference to the abstract journal should be stated with or without an additional reference to the original.

The reader can easily look up the abstract referred to and then decide whether to proceed further. If he finds a reference only to the original, he has the burden of digging through the abstract indexes to learn what the author has learned and could have presented to the reader at the cost of only the reference entry.

The following incident, which actually occurred, illustrates a questionable practice in presenting bibliographical references. A report was received which, in the bibliography at the end, referred to publications in French, German, Japanese, Russian, Indian, and Polish journals but did not refer to the abstracts of the articles. The apparent implication was that the author read the originals or their translations and based his conclusions on an extensive polylingual study. The reader was not helped much by the bibliography except, perhaps, in judging the basis of statements leading to the conclusions, and thereby the third object of citing references was fulfilled.

In general, it is good practice for the author to refer exactly to the journal which he consulted and not necessarily to the original publication quoted there. Unquestionably, reference to the original can be helpful in spe-

cial cases when, for example, the abstract is too brief or pertinent matter is known to be available in the original which does not appear in abstract.

From the reader's viewpoint, references to abstract journals should be made when they represent the basis of the study. References to originals, then, are optional even if helpful. On the other hand, references to original publications should be made if they are the basis of discussion and conclusions. The references to the abstract journals, then, are optional but still may be helpful. Where space permits, both the abstract entry and the original should be cited.

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Concerning the Genera of Amebas

In recent literature the nomenclature of certain free-living amebas has been the subject of considerable discussion (S. O. Mast and P. L. Johnson. *Arch. Protistenk,* 1931, 75, 14–30; A. A. Schaeffer. *Turtox News,* 1937, 16, 114; 1938, 16, 96–97; S. O. Mast. *Turtox News,* 1938, 16, 46–48; Nolan E. Rice. *Biol. Bull.,* 1945, 88, 139–143; R. G. Short. *Biol. Bull.,* 1946, 90, 8–18; R. R. Kudo. *J. Morphol.,* 1946, 78, 317–352; 1947, 80, 93–143; C. G. Wilber. *Trans. Amer. Mic Soc.,* 1947, 66, 99–101). The organisms concerned are the following:

(1) *Amoeba proteus* Leidy, also known as *Chaos diffluens*—the common large laboratory ameba.

(2) *Chaos carolinensis* (Wilson), also known as *Amoeba carolinensis, Pelomyxa carolinensis,* and *Chaos chaos*—the well-known "giant ameba" (Schaeffer, 1937; P. F. Brandwein, P. Penn, and C. Schiel. *Science,* 1943, 98, 431; Kudo, 1946).

(3) *Pelomyxa palustris* Greeff, or *Pelomyxa villosa* Leidy, a less well-known "giant ameba."

Protozoologists who have studied these organisms have no difficulty in distinguishing them from each other and from most other amebas. The confusion is principally in terminology. What should we call organisms 1 and 2? Should organisms 2 and 3 be placed in the same genus? Consideration of these questions leads to the broader question: What are the generic characters of the amebas? The purpose of the present note is to discuss the third one of these questions in the hope of elucidating the answers to the first two.

Schaeffer (Carnegie Instn. Wash., Dept. Marine Biol., Publ. 345, Vol. 24, 1–116), Short, and others have pointed out that organisms 1 and 2 resemble each other in general form. The shape and number of pseudopodia, the ridges on the pseudopodia, and the manner of locomotion are all very similar. For these reasons Schaeffer considered them both to be in one genus, and he designated that genus as *Chaos.* Short, for more or less the same reasons, also considered them to be in the same genus, but decided that the generic name should be *Amoeba.* These two organisms differ in size and in the number and size of nuclei. The first organism has a single large nucleus; the second, several hundred small nuclei. The structure and mitotic behavior of the nuclei, however, are similar in the two species (see Short and Kudo).

Both Mast and Johnson, because of uncertainty concerning the definition of the genus *Chaos,* considered that organism 1 should be in the genus *Amoeba* and that organism 2 should be placed in the genus *Pelomyxa.* Rice considered the differences in size, in number and size of nuclei, number and character of contractile vacuoles, and type of reproduction (binary vs. trinary) sufficient to warrant separate genera and also suggested that the genera be called *Amoeba* and *Pelomyxa.* Kudo arrived at the same conclusion for more or less the same reasons given by Rice.

However, the genus *Pelomyxa,* certainly as represented by the type species, *P. palustris* Greeff 1874, is quite a different animal from organism 2. It is true, as pointed out by Kudo, that both organisms are large and have many nuclei, but in body shape and in the manner of locomotion the two animals are very different. *P. palustris* does not ordinarily form pseudopodia, and certainly it does not locomote by means of pseudopodia.

A very detailed description of *Pelomyxa* is that of Leidy (*U. S. geological survey of the territories,* 1879 Vol. 12), who described *P. villosa.* It is highly probable that *P. villosa* and *P. palustris* are the same species (see Leidy; E. Penard. *Faune rhizopodique du Bassin du Leman,* Geneva, 1902; M. Leiner, *Arch. Protistenk,* 1924, 47, 253–307; and Kudo, 1946), and Leidy has given an excellent description of the locomotion of this organism. He stated that it is more or less leech- or slug-like in shape, with broader anterior end, and that it progresses through the projection of wave-like or hemispherical expansions of the clear ectoplasm in front and on the sides (when turning). It is very definite in Leidy's description that the organism does not normally locomote by means of pseudopodia but by means of protoplasmic waves. He states: "I have not observed *Pelomyxa villosa* assume the branching condition of *Amoeba proteus,* but under undue pressure I have seen it project one or two digitate pseudopods, as in the latter." The locomotion of *P. villosa* is therefore quite different from that of organism 2, which locomotes by means of pseudopodia, as does organism 1.

The type of locomotion of an ameba is one of its principal taxonomic characters. The generic characters, which are based largely on form and locomotion, have been clearly defined by Schaeffer (Publ. 345), but these have been either ignored entirely or merely mentioned briefly in the more recent literature.

For instance, Wilber's recent paper contains the following quotation from a paper by Calkins (*Trans. 15th int. Congr. Hyg. Demogr.,* 1912, 1–19) which was originally published in 1912, 14 years before the monumental paper by Schaeffer. Calkins said: "The nature of the pseudopodia and ectoplasmic and endoplasmic differentiation are unsafe diagnostic characters by which to identify amoebae, for these have been shown to vary widely in the same species under different conditions of environment." This statement is not valid now, and

certainly should not have been considered valid at any time since 1926.

Furthermore, earlier serious students of the amebas —for example, Leidy, Penard, and Cash and Hopkinson (*Publ. Ray. Soc.*, 1905, 85, 1–150)—recognized that the method of locomotion and the form of the pseudopodia were definite taxonomic characters and always included the details of locomotion in each taxonomic description. One of Schaeffer's major contributions was that he systematized these descriptions and defined the genera in such a way as to separate groups of species which differed from each other in form and in methods of locomotion.

Once we recognize that the method of locomotion is a valid generic character and that the number of nuclei can also be used as a generic character (as in the Endamoebidae, *e.g. Dientamoeba*), then the solution to the question of what to call organisms 1 and 2 is obvious. Let us consider that there are three genera: *Amoeba, Chaos,* and *Pelomyxa,* and that the type species are the organisms commonly known as *proteus, carolinensis,* and *palustris,* respectively.

This simple procedure merely divides the genus *Chaos* into two genera: *Amoeba* with one nucleus and *Chaos* with many nuclei. It violates no principles pertaining to generic characters as defined by Schaeffer (Publ. 345). It violates no international rules, except for the spelling of *Amoeba,* which perhaps should be *Amiba,* because in 1830 Ehrenberg changed the original 1822 spelling of Bory. A return to *Amiba,* however, would probably not be acceptable to most zoologists.

The question of the specific names of organisms 1 and 2 is still open to discussion, *i.e.* whether organism 1 should be called *Amoeba proteus* or *A. diffluens* and whether organism 2 should be called *Chaos carolinensis* or *C. chaos.* The answers to these problems hinge on the question of what organism some of the early investigators really saw. This cannot be determined with certainty. Therefore, the simplest solution seems to be to accept the earliest name that is accompanied by a description so adequate that modern students of the amebas feel fairly certain in recognizing the same organism at the present time. The earliest description which most students are willing to accept unequivocally as applying to organism 1 is that of Leidy; the species, therefore, should be *proteus,* as emended, however, by Schaeffer in his *Ameboid movement* (1920). For organism 2 the earliest unequivocal description is that of Wilson (*Amer. Nat.*, 1900, 34, 535–550); the species, therefore, should be *carolinensis.*

This gives us the three names *Amoeba proteus, Chaos carolinensis,* and *Pelomyxa palustris* as those which should be applied to organisms 1, 2, and 3, respectively.

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Effect of Formaldehyde on *Picea* and *Tsuga* Herbarium Specimens

F. R. Fosberg (*Science,* September 12, 1947, pp. 250-251), in reporting the use of formaldehyde-alcohol mixtures in the preparation of herbarium specimens, suggests that the use of this technique might prove beneficial in preparing such specimens of *Tsuga* and *Picea* and the cones of *Abies,* all notorious for disarticulation upon drying.

To test this suggestion, specimens were prepared from available fresh material of both *Tsuga* and *Picea,* green cones of *Abies* being out of season. Specimens included one species of *Tsuga* (*T. canadensis*) and 10 species of *Picea* (*asperata, bicolor, excelsa, glauca, mariana, Omorika, orientalis, polita, pungens,* and *Wilsonii*). The specimens were made in duplicate, one of each species to be dried by the customary method to serve as a check on the chemically treated one. The specimens to be treated were dipped in a formaldehyde-alcohol mixture made according to Fosberg's formula and then placed in a plant press with the untreated ones. Artificial heat was used to facilitate drying.

Examinations made during the drying period showed, as expected, that the chemically killed material was drying faster than the untreated specimens. In both cases, however, as drying became complete, the needles fell from the twigs if they were touched or slightly jarred. There were some discernible specific differences in the ease with which the needles broke free, the heavier-leaved Asiatic species showing more resistance to fracture than some of the finer-leaved species.

From these results it was concluded that this type of chemical treatment is without value in the preparation of herbarium specimens from this type of material.

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TECHNICAL PAPERS

Determination of the Fate of Phosphorus in the Laying Hen by Means of Radiophosphorus (P^{32})[1]

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During the past few years radiophosphorus (P^{32}) has been used in a number of studies with hens (*1–6*). In these studies the P^{32} was either injected as disodium hydrogen phosphate or fed as phosphoric acid. While these results are of value in studying the fate of phosphorus, the methods of administering the phosphorus are not ordinarily used in poultry feeding. Since bone meal (consisting mainly of calcium phosphate) is a common source of phosphorus in poultry rations, an experiment in which this ingredient was replaced by calcium phosphate containing P^{32} was carried out.

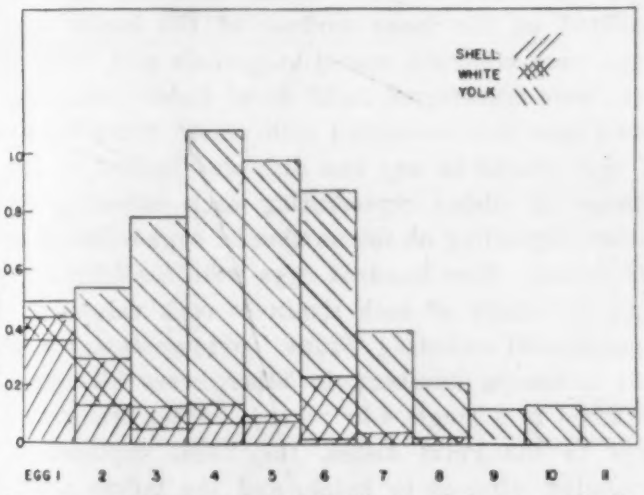

FIG. 1. Percentage of phosphate, fed as a single dose of radioactive $Ca_3(PO_4)_2$, appearing in successive eggs.

In a typical experiment the bone meal (1%) in a laying mash was replaced by 700 mg of $Ca_3(PO_4)_2$ with a P^{32} activity of approximately 10^5 disintegrations/min. In the first trial a hen was given a single feeding of P^{32}. The eggs laid subsequently were hard boiled and separated into shell, white, and yolk. After wet ashing, the phosphorus was converted to magnesium pyrophosphate and its activity determined. After allowing for self-absorption of the sample and decay of the P^{32}, the percentage of phosphate appearing in the different parts of the egg could be determined. About 5% of the phosphorus fed as calcium phosphate appears in the egg, over 80% of this being in the yolk. The P^{32} appearing in successive eggs for this hen is shown in Fig. 1.

[1] We are indebted to the National Research Council of Canada for financial assistance.

If, now, a hen is fed the same dose of active $Ca_3(PO_4)_2$ each day, the amount of labeled phosphorus appearing in each egg should eventually reach an equilibrium value equal to the total measured above, provided the hen is laying at a fairly uniform rate (see Fig. 2).

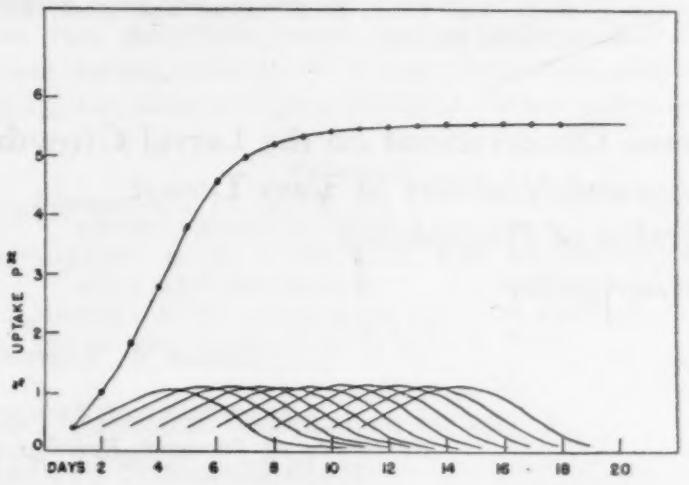

FIG. 2. Graph showing approach to equilibrium in the multiple-feeding experiment, as a summation of the phosphorus distributions for a number of successive feeds.

In order to test this theory, another hen was fed a diet containing 700 mg of calcium phosphate, having the same activity each day at the time of feeding. The results are illustrated in Fig. 3. The hen was fed P^{32} for a period of 25 successive days. These results fit in very well with the idea outlined above.

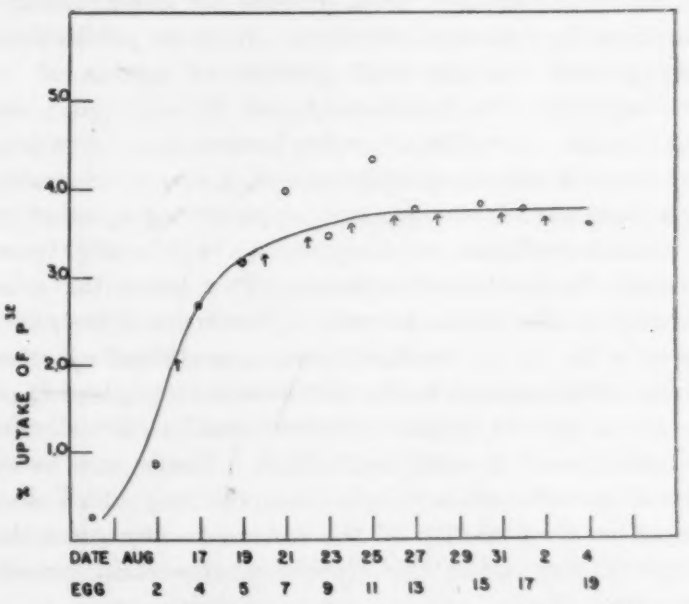

FIG. 3. Percentage of daily feed of phosphate appearing in successive eggs in sustained feeding experiment. (Arrow indicates egg laid but not analyzed.)

It is of interest to record that the phosphorus fed to the hen on a given date was still appearing in the eggs a month later. At this time, the phosphorus must have been coming from the muscles and the bones. This possibility

was confirmed by an analysis of the left tibia of the bird, which 40 days after feeding, showed about 7% of the phosphorus fed.

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Some Observations on the Larval Growth Rate and Viability of Two Tumor Strains of *Drosophila melanogaster*

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In a recent paper (*3*) it was pointed out that spontaneous tumors occurring in several genetic tumor strains of *Drosophila melanogaster* showed marked decrease in incidence if the cultures were maintained at a temperature of 30° C. While at lower temperatures responses in terms of incidence varied considerably in the several strains studied, the decrease in incidence at the high end of the range was uniform for all.

The nature of this decrease in incidence is of considerable interest, since the temperature change, like any environmental change, must produce its effect through the physiology of the individual. In their publications dealing with viability and survival of strains of *D. pseudoobscura* (*1*), Dobzhansky and Spassky point out that the survival values of strains homozygous for various chromosomes including wild types may vary considerably with temperature change, even approaching a lethal or semilethal condition at temperatures which might not normally be considered extreme. This being the case, one may wonder if the decrease in tumor incidence noted above is the direct result of such a semilethal or other similar effect related to the chromosomal complement of the tumor strains, which manifests itself at 30° C. On the other hand, it could result from a factor such as an altered growth rate at higher temperature, which does not affect the viability of the culture to any great degree, but may affect the expression of certain genetic characters (*2*).

The paucity of studies dealing with temperature effects on larval growth and survival in tumor strains has made it necessary to probe a few fundamental points before undertaking any detailed investigation of growth rate or survival in relation to the tumor problem.

First, we should have some idea of how the range of 20°–30° C affects the viability of the tumor strains. Second, it would seem important to know if there is any significant variation of growth rate in tumor strains which results from altered temperatures within this range. Finally, if there is variation, does each strain have its own level of reaction, or do they all respond in about the same way? Some preliminary answers to these questions may be found in the data presented in this report. These data are admittedly far from quantitative, since they are derived from experiments set up only as precursors to more thorough studies. They are published now largely as a supplement to the paper mentioned above (*3*).

Two of the tumor strains used in the previous investigation were selected as the basis for this study. These were of the genetic make-up bw tu (a strain showing high incidence of tumors at room temperature as well as low constant temperature, but showing sharp decline at 30° C), and st sr e^s ro ca, tu-36a (a strain low in incidence at 20° C and at 30° C, but showing increased incidence between these extremes). A Burlington, Vermont, wild strain was selected as a control. All three strains were fairly closely inbred, but could not be considered isogenic.

Cultures of these stocks were put in half-pint bottles which were placed in incubators set at 20° ± .5° C, 25° ± .5° C, and 30° ± .5° C. From these cultures eggs were collected on yeast-seeded molasses agar blocks, mounted on the inner surface of the bottle cap (*4*). Eggs were collected over 4-hr periods and, after collection, were transferred to 4″ Petri dishes containing molasses agar well inoculated with yeast. Since the number of eggs placed in any one dish was limited to 150, the number of dishes representing each collecting "run" varied, depending on the number of eggs collected during the period. Five hundred eggs were considered a minimum for study of each strain at each value. In some cases several collecting "runs" were necessary to gather this minimum number; in other cases all eggs were gathered in a single 4-hr period. After transfer of the eggs to the Petri dishes, they were replaced in the incubator, allowed to hatch, and the larvae allowed to develop. Fresh yeast was added from time to time to insure optimum food conditions in all cultures.

Since larval growth only was of interest, the time of pupation, marking the end of the larval period, was used as the basis for comparison of growth rate. The end point arbitrarily selected was the time when the number of pupae equaled half the number of eggs started. In timing the "runs," the 4-hr collection period was not included, the start of the "run" being set as the time of transfer of eggs into the Petri dishes.

Table 1 sets forth the data for the three strains at the three temperature values. Since the cultures were not under constant observation, but were examined at intervals during the day, the end point of 50% pupation is not exact, and the allowance for error in terms of elapsed time between the final reading and the one previous to it is stated. In a few cases this interval was overnight, and so is quite large. However, in these cases it will be noted that this large interval does not

confuse the results obtained. The number of pupae present at the time of final reading is also stated.

Upon consideration of these data, the first fact that stands out is that neither tumor strain has even 50% viability at 30° C, since both fail to reach the end point. Whether this represents sterility induced by high temperature or a failure to develop which may be regarded as a lethal or semilethal condition is not at present determined. It is clear, however, that in these tumor strains the reduction in tumor incidence at 30° C is accompanied by reduced viability.

TABLE 1

GROWTH RATE OF LARVAE AT THREE CONSTANT TEMPERATURE LEVELS

Run No.	No. of eggs	No. of pupae at final reading	No. of hrs to final reading
		30° ± .5° C	
		st sr stock	
1	203	92 (total pupation for run)	144–4
2	105	39 " " " "	158–3
3	271	92 " " " "	143–4
		bw tu stock	
1	200	79 (total pupation for run)	160–14
2	240	104 " " " "	141–2
3	225	93 " " " "	147–3
		wild stock	
1	530	296	113–14
		25° ± .5° C	
		st sr stock	
1	60	31	138–3
2	90	46	150–4
3	220	111	160–14
4	200	109	147–4
		bw tu stock	
1	140	72	142–3
2	120	61	165–4
3	311	200	142–4
4	110	62	142–4
		wild stock	
1	625	313	122–4
		20° ± .5° C	
		st sr stock	
1	744	414	213–4
		bw tu stock	
1	355	190	192–4
2	304	155	200–4
		wild stock	
1	712	356	260–2

As a second point, it would seem that the developmental rate of larvae of all three strains is, as might be expected, markedly slower at 20° C than at 25° C or 30° C, the control showing the slowest development of the three at 20° C and the fastest at the other two levels. On the basis of the results obtained, a comparison of control and experimental strains at 30° C is not justified, since the figure noted under control represents pupation of 50% of the eggs started, while those noted for the tumor strains represent total pupation. This total is, of course, less than 50%. Therefore, restricting present consideration to the 20° C and 25° C levels, it is interesting that both tumor strains develop more slowly at the higher temperature than does the wild, but more rapidly at lower temperature. The bw tu strain is evidently the least retarded at 20° C.

Finally, as far as can be noted in this work, viability is no different in the three strains at the lower temperature levels. In terms of tumor incidence this is confusing, since bw tu shows high incidence at 20° C, while st sr shows much-reduced incidence at this temperature. The fact that viability is not reduced in st sr probably indicates that this reduction in tumor incidence is dependent on other factors than that noted in the two strains at 30° C. Some clue bearing on this may lie in the fact that these tumor strains do have different developmental rates at 20° C, and this is now being investigated along with other phases of the tumor problem.

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High Insulin Tolerance in an Inbred Strain of Mice

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A case of extreme tolerance to insulin has been found in an inbred strain of mice. It is inherited. Cases of high insulin resistance are of interest in connection with carbohydrate metabolism and the possible mechanism of insulin action, and inherited variations are important in view of the recognized procedure of assaying the potency of insulin by determining the convulsive dose in white mice (*5, 6, 9*). Although controls involving temperature and food consumption prior to injection are generally practiced, controls involving possible hereditary variations in these white mice are not considered. An hereditary difference of the magnitude found in our strain is also of interest in connection with the sort of physiological differences that may be inherited and the possible extent of such variations in man.

Differences in insulin tolerance have been described for some classes of vertebrates. Many birds (quail, pigeon, fowl, etc.) have a higher tolerance to insulin than do mammals (*2, 3, 4*). Likewise, certain differences in insulin tolerance have been noted within a single species. In humans, cases of extremely high insulin resistance have been observed among some diabetic patients (*8*). McIntyre and Burke (*7*) found in albino rats one strain which had a tolerance 10 times as high as the standard strains. In mice, Allen (*1*), using an unspecified number and type of mice, reported the dose necessary for beginning shock to be 1,000 units/kg. These results are con-

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siderably higher than those reported by Chen, *et al.* (*3*), who found the convulsive dose to range from 7 to 40 units/kg.

In the present study death is taken as the criterion of tolerance. Convulsive doses parallel the death results but are more irregular. Three inbred strains of the University of Illinois colony were used: KL—albinos, derived and inbred for 15 brother-sister generations at Illinois; Zr—pink-eyed, brown (café-au-lait) and white spotted, derived and inbred for 10 brother-sister generations at Illinois; and C57 Black—the stock of Jackson Memorial Laboratory, Bar Harbor, Maine, representing total inbreeding of over 40 generations.

The insulin used was Iletin (Insulin, Lilly), in concentrations of 20, 80, 100, and 500[2] units/cc. Injections were intravenous, intraperitoneal, or subcutaneous. Control injections of comparable volumes of mammalian Ringer's solution were used. Animals were tested at different ages and weights.

Results of the experiments indicate that survival of the tolerant strain is the same for intraperitoneal and subcutaneous injections, even though the latter must involve slower absorption. No sex differences are found. Young mice up to 15 days give nearly the same response for all strains (some individuals will tolerate 5 units), but from 20 to about 35 days there is a rapid divergence of tolerance which appears to consist of a somewhat increased sensitivity for the Zr strain and a greatly decreased sensitivity for the KL strain. Table 1 groups the data involving the three strains. A further peculiarity of the KL strain is that with high doses, death is sometimes delayed up to 3 and 4 days as compared with the usual insulin death within 24 hrs (maximum, 30 hrs). Other strains have been compared at some of the comparable ages and weights. An albino strain (Zrc), a wild type (Surv A), the black silver strain (Si), all agree with the C57 Black results. Only strain L (from "Swiss" albinos and one parent of the KL strain) approached the high tolerance level.

At 30–40 days it is evident that some KLs will tolerate up to 750 times the amount tolerated by Zrs or, since KL is heavier, up to 590 times/kg (31–18,300 units). Taking approximately 17 gm as a typical weight used in insulin assays and studies, we find maximum amounts tolerated at that weight to be 1, 3, and 300 units for Zr, C57 Black, and KL, respectively. In terms of units per kilogram (calculated from Table 1) this becomes 59 for Zr, 201 for C57 Black, and 18,300 for KL, an amount tolerated by KL which is 310 times that by Zr. Or, if the lowest dose which kills is considered for this approximate weight, we find 1 unit for Zr and C57 Black and 240 units for KL. In units per kilogram this becomes 59, 67, and 14,640, respectively.

In the extremely rapid increase in tolerance of the KL strain from 20 days to 30–40 days, the units tolerated increase from 2 to 120 to 300 for 20, 25, and 30–40 days.

TABLE 1
INSULIN TOLERANCE OF 3 STRAINS*

Age (days)	Av. wt. (gm)	Strains	Alive	Dead
20	8	Zr	.05, .1, .8	.5(3), 1(3)
		C57 Blk		
	8	KL	.4, .8, 1, 2(2)	.8, 5
25	9	Zr		1(4)
	8	C57 Blk	.2	.8, 2
	13	KL	.5, .8, 4, 15, 50, 120	190
30–40	13	Zr	.3, .4	.8(2), 1.2, 1.6, 2(2), 5, 80
	15	C57 Blk	.1, .5, .8, 1(2), 1.5, 3	1, 1.5, 2, 3, 5(3), 10, 15
	16.5	KL	50, 60, 100(4), 160, 180, 200, 300	240, 250, 260, 500
45–85	17	Zr	.3, 1	1, 5
	23.5	C57 Blk	.6, 3, 4, 8(2)	2, 3(2), 4, 5, 8(3), 10, 12(3), 16(2), 20, 25, 32
	27	KL	40, 70, 100(2), 160(3), 200(4) 240, 300(2), 400, 500(4)	400, 750†, 1250†(2)
95–175	24	Zr	5(3)	5, 80(5)
	25.5	C57 Blk	5(2), 10, 20(2)	15, 40(3), 50, 80
	34	KL	80(6), 300, 500(3), 600	400, 500†, 1000, 1000†, 1500
365	26	Zr	5(2)	
	26	C57 Blk	20	4, 40
	36	KL		500, 1000

* Numbers are units of insulin given. Numbers in parentheses indicate number of animals given that dose, otherwise one animal for each dose.

† Died late (3 and 4 days).

[2] The 500-unit insulin used was Iletin (Insulin, Lilly) U–500, of lot number W–1819–2, and was obtained through the courtesy of F. B. Peck, associate director, Medical Division, Research Laboratory, Eli Lilly and Company, Indianapolis, Indiana.

In units per kilogram this is 250 to 9,240 to 18,300 in an interval of less than 20 days.

In genetic tests between KL and Zr (Table 2) there is a suggestion that extreme tolerance is a single factor recessive. Using 80 units as a test dose, the F_1s all died, the F_2s approximate a 3:1 ratio (2.3 × SE), the combined first backcross 18:30 fits a 1:1 ratio (1.7 × SE), and the second backcross 4:8 agrees with the first. It should be pointed out, however, that 80 units used as the test dose might arbitrarily divide the distributions due to multiple factors in approximately this manner. Zr and KL would then consist of distributions widely separated and on opposite sides of this arbitrary threshold. In agreement with this possibility are 7 animals of the first backcross which, at 100 days, lived with 5 units, 2 with

TABLE 2

CROSSES BETWEEN KL AND Zr*

	Alive	Dead
KL strain	All	
Zr strain		All
F_1		7
F_2	15	21
BC to KL♀ (F_1♂ × KL♀)	15	9
BC to KL♂ (F_1♀ × KL♂)	15	9
2BC to KL♂ (BC♀ × KL♂)	8	4

* Test dose used is 80 units of insulin. Numbers refer to number of animals. ♀, used in second backcross (2BC), died when tested with 80 units.

200 units, and 4 which died with 500 units (one, however, died only at 3½ days, typical of KL). Also, with 50 units 3 F_1 mice lived and 1 died, although none lived with 80 units. Segregation with 80 units is demonstrated, but this does not necessarily constitute a proof of one factor with dominance. A more plausible explanation involves many factors with little or no dominance, the 80-unit test dose giving an artificial cleavage which simulates single-factor segregation.

The magnitude of the difference is too great to be explained on the basis that KL is mildly diabetic or hypoglycemic. However, a blood sugar analysis was made (Folin and Malmros micro method). The results are very similar for all strains tested. In milligrams per cent the sugar levels for uninjected mice are 170 for Zr, 172 for C57 Black, and 171 for KL.

In conclusion, the KL strain of mice has an extremely high insulin tolerance. For a given age or weight, the tolerance is of the order of a few hundred times that of strain Zr or C57 Black. Blood sugar levels for uninjected mice are essentially the same for these three strains. Evidence from crosses between KL and Zr, using an 80-unit test dose, simulate for F_1, F_2, first and second backcrosses, a single factor recessive for high tolerance; but more probably this is a dichotomy by the test dose of continuous distributions due to many factors. The necessity of control of the genetic constitution of animals used in the bioassay of insulin is self-evident.

Insulin tolerance or resistance of such a magnitude can be used to study the nature of insulin action in carbohydrate metabolism or, more specifically, the nature of antagonistic or neutralizing reactions.

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Introduction of Radioactive Sulfur (S^{35}) Into the Penicillin Molecule by Biosynthesis[1]

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It has been found possible to introduce radioactive sulfur into the penicillin molecule by biosynthesis. The radioactive penicillin was produced by surface growth of the mold, *Penicillium notatum* NRRL 1249 B 21, on a synthetic medium (*2*) containing radioactive sulfur as sodium sulfate. The total sulfur available in the 272 liters of medium was 16.475 gm of S^{32} and 0.528 γ, or 24.2 mc of S^{35} present as inorganic sulfates. The ratio of S^{35} to S^{32} was therefore 3.12×10^{-8} in the original medium. The mold was harvested 10 days after inoculation of the medium and the crude or amorphous penicillin extracted. The total yield was 53.31 gm of amorphous penicillin having an average antibiotic activity of 2.47×10^5 Oxford units/gm and a specific radioactivity of 15.56 μc/gm. Hence, 3.4% of the original radioactivity was found in the amorphous penicillin.

A small portion of the amorphous penicillin was purified by G. T. Barry and Y. Sato, National Institute of Health Fellows, at the Rockefeller Institute for Medical

[1] Summary of a paper presented before the Antibiotic Study Section, National Institute of Health, Bethesda, Maryland, October 1, 1947.

The radioactive sulfur used in this investigation was supplied by Monsanto Chemical Company and obtained on allocation from the U. S. Atomic Energy Commission.

Research, using the countercurrent distribution method (*1*). In one run, for example, a 24-tube transfer study was made with 508 mg of amorphous penicillin. The weight and antibiotic activity curves showed that the major portion of the penicillin was type G with a little F and dihydro F but no K or X. The yield of crystalline triethylamine penicillin G (m.p., 140–150° C) was 50 mg, having 60.54% carbon and 7.68% hydrogen. This crystalline penicillin G and the corresponding amorphous penicillin were assayed antibiotically, chemically, and radioactively, giving the following percentage recoveries in going from the amorphous to the crystalline material:

Weight	*Oxford units*	S^{32}	S^{35}
8.1	27.0	31.1	31.9

Hence, (1) the radioactive sulfur is incorporated into the penicillin molecule, and (2) all the sulfur in the amorphous penicillin must be present in the penicillin molecule, since the sulfur assay agrees with the antibiotic assay. The smaller weight recovery for the penicillin G reflects the presence of phenyl acetic acid and pigments in the amorphous material.

A comparison of the radioactivity of the purified salt with the calculated sulfur gave a ratio of S^{35} to S^{32} of 3.04×10^{-8} for the example cited above. This compares favorably with 3.12×10^{-8} in the original medium. Hence, the radioactive sulfur behaves just as ordinary sulfur in the biosynthesis. This is also shown by the table above.

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Interference With Estrogen-induced Tissue Growth in the Chick Genital Tract by a Folic Acid Antagonist

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Earlier observations (*4*, *5*) indicated that the characteristic tissue-growth responses to estrogen in the genital tract of both the female monkey and the chick require adequate dietary intake of folic acid. Moreover, a close quantitative relationship between the level of folic acid ingestion and the response to estrogen was shown.

Extensive reports have described the nature of competitive metabolites which interfere with the biological activity of various members of the B-complex and certain amino acids (*3*). However, interference with the biological activity of a hormone by the competitive displacement of an essential dietary factor has not hitherto been described. We wish to report that the ingestion of the folic acid antagonist[1] described by Franklin, Stokstad, and Jukes (*2*) markedly reduces the tissue-growth response to maximally effective doses of diethylstilbestrol in the chick maintained on an otherwise normal stock diet.[2] Representative findings are presented in Table 1.

The data indicate that this antivitamin possesses the capacity to reduce the formation of new tissue in an organ which is under maximal hormonal stimulation for rapid growth. It is particularly noteworthy that such an inhibitory effect can be obtained in animals fed a natural grain diet and that this inhibition is promptly and completely reversed by the administration of an excess of synthetic folic acid (pteroylglutamic acid).

TABLE 1

Series	Additions to stock diet	Stilbestrol injected*	No. of chicks	Oviduct weight (mg)	Body weight (gm)
A	1% Antagonist	+	9	67 ± 16	56 ± 5.9
	1% Antagonist plus folic acid†	+	13	315 ± 52	62 ± 7.1
	None	+	10	263 ± 52	74 ± 9.6
B	1% Antagonist	+	7	65 ± 32	47 ± 5.2
	None	+	7	243 ± 47	73 ± 11.2
	"	−	10	16 ± 3	76 ± 12

* All stilbestrol-treated chicks given 0.5 mg of stilbestrol daily in 0.1 cc of corn oil subcutaneously for 4 days preceding autopsy.

† Each chick given 4 mg of folic acid (synthetic pteroylglutamic acid) in 0.5 cc of 0.01 N sodium hydroxide subcutaneously daily during 4 days of stilbestrol treatment only.

All chicks are New Hampshire Reds from the same flock and autopsied on 12th day after hatching.

Substantial retardation of cancer of the prostate and breast has been shown to result from the partial elimination from the body of the hormones involved in the normal metabolism of these organs (*1*, *6*). Accordingly, the further exploration of any mechanisms which may even more effectively interfere with the physiological activity of such hormones in the body seems desirable. The direct reduction of the nutritive value of certain vitamins and amino acids with a view to the impairment of tumor growth has been suggested previously (*3*, *7*). Our observations offer the additional possibility of interference with hormone-induced tissue growth by nutritional means.

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[1] The material used in this study was kindly supplied by the Lederle Laboratories through the courtesy of Y. Subba-Row and B. L. Hutchings.

[2] Startena (Ralston Purina Co.).

IN THE LABORATORY

A Method for Silvering a Dewar Flask for Optical Experiments

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For the purpose of studying the interaction of light with various organic compounds at the temperature of different liquid gases, an all-quartz Dewar flask with optical windows was obtained.

The silvering of the space to be evacuated without also silvering the windows presented something of a problem, the following solution of which was thought to be of possible interest to other workers.

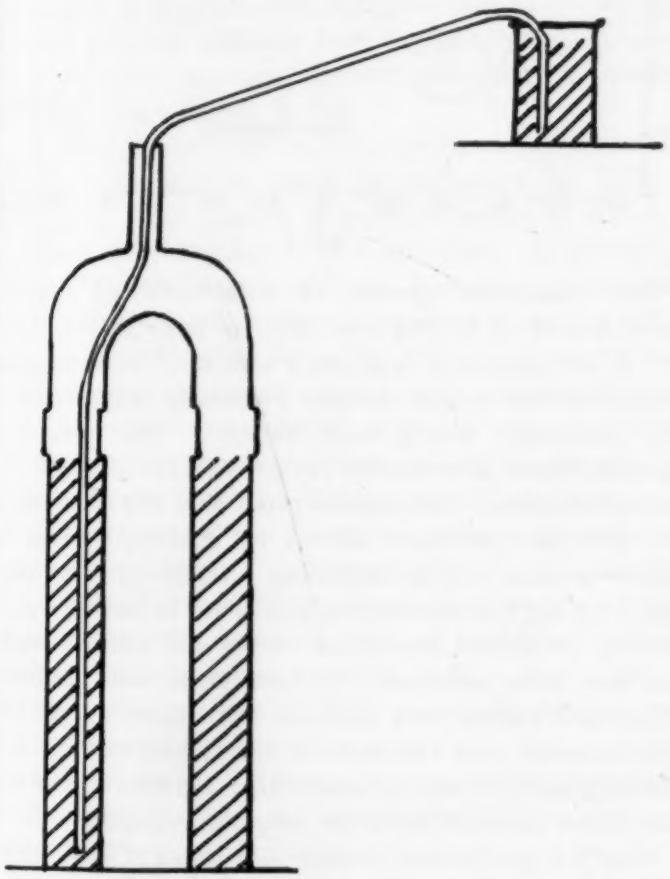

FIG. 1

It was necessary to introduce the silvering solution through an inlet of 5-mm diameter. A #12 French ureteral catheter (available through any surgical supply house) was employed. With the Dewar inverted, the solution was introduced through the catheter by siphon action to the level of the windows (Fig. 1); the catheter remained in place the requisite time for silver deposition and served to siphon off the spent solution. The deposit was then gently washed with distilled water.

To silver the area between the bottom of the flask and the windows, the Dewar was held upright, the catheter placed above the desired fluid level to release the air displaced by the solution, and the silvering solution introduced by gravity through a rubber tube placed over the

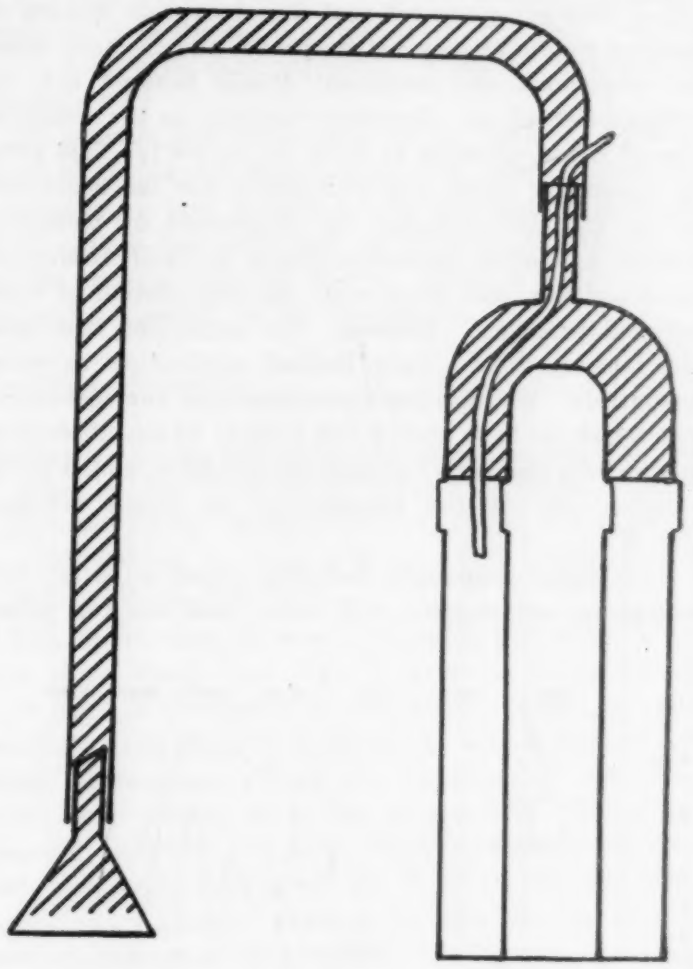

FIG. 2

inlet. The outlet of the catheter was exteriorized through a hole in the rubber tube (Fig. 2).

The remaining unsilvered band about the flask—at the level of the window—was silvered in two steps with the

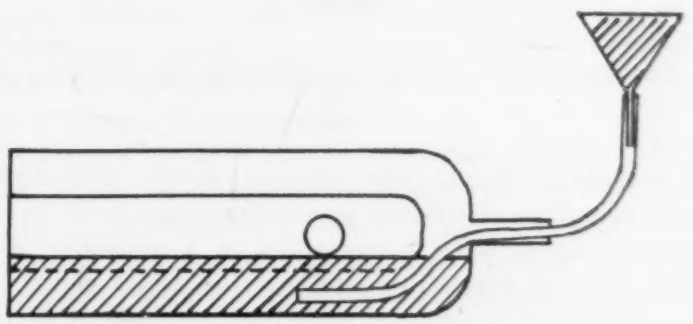

FIG. 3

flask in the horizontal position, as illustrated in Fig. 3, the catheter again being used as a siphon tube. The end result was complete silvering of surfaces of the space to be evacuated save for a square area enclosing the circular windows.

Low-Temperature Spectroscopy of Biological Compounds[1]

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It is well substantiated that the absorption spectra of complex molecules may be sharpened, and in many cases the vibrational and rotational details brought out, by refrigeration of the absorbing material to the temperature of liquid nitrogen or lower (*1, 3, 5–7*). This principle seems of great potential utility for the characterization and differentiation of compounds of biological interest heretofore indistinguishable by their absorption characteristics, and conceivably for the solution of cytochemical problems. However, the techniques that have been employed have only limited application to polar compounds. We have therefore developed new techniques with which we have undertaken a study of the absorption spectra of a number of purines, pyrimidines, amino acids, proteins, etc. at the temperature of liquid nitrogen (77° K).

Many polar compounds including amino acids (*2*) will sublime at temperatures well below their melting points

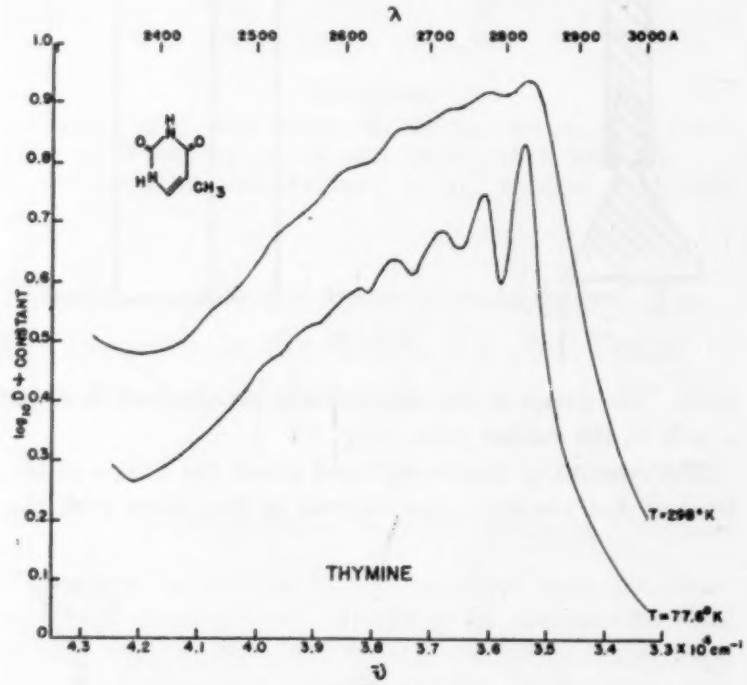

FIG. 1

at reduced pressures. This principle has been used to prepare thin films of purines, pyrimidines, and amino acids, by sublimation onto quartz slides in a molecular still. Thin films of nucleotides and proteins, which could not be sublimed in this manner, have been prepared by drying water solutions on a clean, hydrophilic quartz surface. Details of the techniques will be given in a later paper.

[1] This work was aided by a grant from the American Cancer Society recommended by the National Research Council Committee on Growth.

[2] Fellow, Cancer Research Division, Donner Foundation, Philadelphia, Pennsylvania.

[3] Predoctoral Fellow, American Cancer Society.

Absorption spectra of the thin films were obtained at room temperature and with the slides immersed in pure liquid nitrogen contained in an all-quartz Dewar flask (*4*), designed with four plane quartz windows for passage of the ultraviolet radiation. An Hanovia hydrogen discharge tube and a small Hilger quartz spectrograph were used. The graphs were obtained from the Sinclair-Smith recording microdensitometer traces of the spectrum plate density.

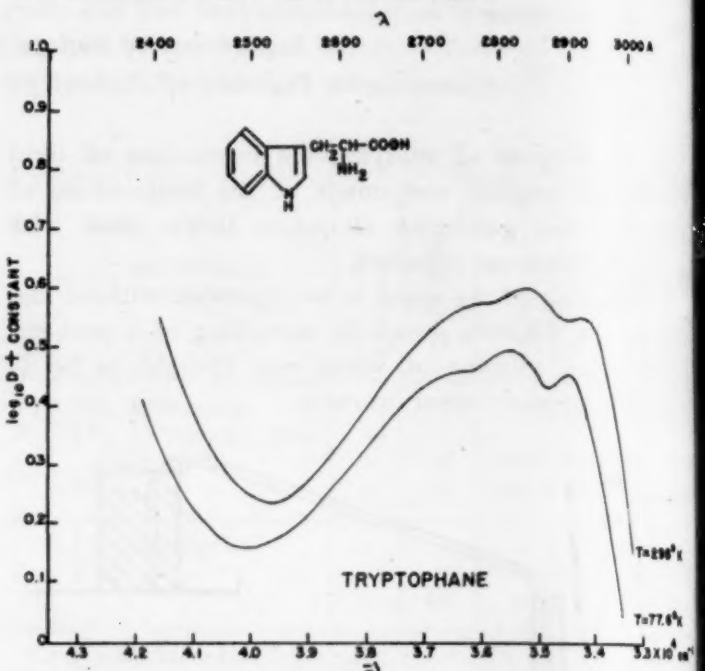

FIG. 2

The absorption spectra of such sublimed films of thymine and of tryptophane at room temperature and at 77° K are presented in Figs. 1 and 2. The spectra are plotted as log optical density (which is independent of film thickness) versus wave number. The increase in spectral detail is evidently far greater for thymine than for tryptophane. Reasonable proof that the materials on the film have not been altered by sublimation was obtained in each case by subliming a relatively large quantity (1–2 mg), dissolving the sublimate in buffer, and obtaining ultraviolet absorption curves and nitrogen analyses from these solutions. In both cases such ultraviolet absorption curves were identical with those of the original material, and the ratio of ultraviolet absorption to nitrogen content was in satisfactory agreement with similar ratios obtained upon the original material.

This is a preliminary report on a series of such studies to be extended to lower temperatures and to other regions of the spectrum.

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Book Reviews

Approaches to tumor chemotherapy. (Ed. by F. R. M.) Washington, D. C.: American Association for the Advancement of Science, 1947. Pp. 442. (Illustrated.) $6.50, members; $7.75, nonmembers.

Since 1938, a series of annual conferences, each lasting a week, have been held at Gibson Island, Maryland, under the sponsorship of the Section on Chemistry of the AAAS. The week devoted to cancer research in 1945 was given over largely to a symposium on tumor chemotherapy, and through the enthusiasm and industry of the chairman of this conference, Dean Burk, all the papers devoted to this subject, together with papers on similar subjects in 1946 and a number of invited papers "designed to round out a fairly representative view of the present status of the field of tumor chemotherapy," have been gathered together and published in a single volume. Seventy different authors have contributed 41 papers. The discussions by many persons attending the conferences have been added in full.

The book opens with a most discouraging historical review of the field of tumor chemotherapy by William H. Woglom. The number of negative results in this field as described by Woglom is indeed legion. A section on "Special Methodology" follows. The third section, entitled "Nutritional Factors," contains, among other papers, a lengthy symposium by Richard Lewisohn and his co-workers describing their animal experiments with folic acid and allied substances in the treatment of transplanted and spontaneous cancer in mice. Papers by Sugiura and by Zahl and Hutner record failures to confirm the findings of the Lewisohn group, and a similar failure is recorded in the discussion by Morris. In view of the recent interest in the press over the clinical use of teropterin and diopterin, two of the folic acid derivatives, this discussion is timely. It is surprising to find how little evidence there is in animal experimentation for the use of these substances.

A section entitled "Bacterial Products" includes a series of 13 papers by the investigators at the National Cancer Institute at Bethesda, Maryland, and the Lankenau Hospital, Philadelphia, led by M. J. Shear and Stanley P. Reimann. These contributions suffer a bit from having waited two years and a half for publication. This is particularly true of the description by Theodore Hauschka of the possible treatment of cancer with *Trypanosoma cruzi* or its products (KR serum). Hauschka's subsequent contributions have shown disappointing results with this material.

A series of 7 papers on the chemical nature, biological action, and clinical application of the nitrogen mustards give one the impression that these substances cause very marked effects in some cases of lymphosarcoma and Hodgkin's disease, but that these effects are transitory and probably not as useful as similar changes which can be produced with therapeutic roentgen rays. Much clinical experience is recorded in this section.

The final section, entitled "Various Clinical Aspects," contains 6 somewhat heterogeneous papers. Two of these deal with the interesting effect of urethane in leucemia.

No attempt has been made by the reviewer to catalogue all the papers in this interesting volume—obviously an impossible task in such a brief description—but perhaps enough has been said to convince the worker in cancer research that the present volume is both interesting and a "must" on his reading list.

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Erdkunde: Archiv für wissenschaftliche Geographie. Released by Carl Troll, ed. by Herbert Lehmann.) Bonn, Germany: Ferd. Dummlers Verlag, (22c) Kaiserstrasse 33/35. Band 1, Lfg. 1–3, pp. 120 (released May 1947). Band, RM. 24.–.

This is the first German geographic periodical to appear since World War II, and, as such, it sets an historic mark in the annals of professional geography. Beneath the mass of unhappy humanity that is postwar Germany, professional groups are beginning to sort themselves out. Among these, the geographers, with a 100-year-old tradition stemming from, and established by, such men as A. von Humboldt, C. Ritter, F. von Richthofen, and F. Ratzel, are beginning to stir and to offer printed evidence of their interest.

Erdkunde is in the best tradition of prewar German geography. It seeks to fill the gap and to follow the pattern of *Petermanns Geographische Mitteilungen* of the Geographischen Anstalt Justus Perthes, and the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin.* Carl Troll and Herbert Lehmann, both of the prewar Geographisches Institut of the University of Berlin, are among the best in German geography. Carl Troll has a well-known record of opposition to the pseudoscientific infiltration of Haushofer-Geopolitik to the realm of scientific geographic research.

This issue of *Erdkunde* itself is notable for its 45-page lead article, the first of two installments, by Carl Troll under a title translated to read, "The Science of Geography in Germany, 1933 to 1945: A Critique and Justification." This is an excellent evaluation, tracing the Nazi attempt to corrupt the content of scientific geographic thought and research; the manner in which German geography was organized into societies, its meetings and periodicals; the great tragedy of the geopolitical doctrine and of the Haushofer family; the general concepts of the subfields of geography; and geographic research and expeditions in foreign lands, naming individual geographers and their work (to be fol-

lowed, in the next issue, by the research goals and findings of the subfields of geography). Whatever one's personal postwar feelings toward things German may be, there can be no doubt of the integrity of the writer, Carl Troll. He, and other staunch professionals of the Geographisches Institut of the University of Berlin (Albrecht Penck, Norbert Krebs, Alfred Rühl, Herbert Lehmann, Julius Büdel), stood up against the Nazi tide, and only at the very end were forced to disperse, leaving others to give in to the general corruption.

In addition to this highly illuminating document by Carl Troll, there are three major articles; three shorter notes; several book reviews; and an address list of 180 German geographers, 5 named whose whereabouts are unknown, 1 in Australia, 1 in Brazil, and 23 listed as dead (12% of the total).

MALCOLM J. PROUDFOOT

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Scientific Book Register

BEITMAN, M. N. (Compiler.) *Most-often-needed F. M. and television servicing information.* Chicago: Supreme Publications, 1948. Pp. 192. (Illustrated.) $2.00.

BLAKE, MARION ELIZABETH. *Ancient Roman construction in Italy from the prehistoric period to Augustus.* (Publ. 570.) Washington, D. C.: Carnegie Institution of Washington, 1947. Pp. xxii + 421. (Illustrated.) $9.00, paper; $10.00, cloth.

CHAPIN, F. STUART. *Experimental designs in sociological research.* New York-London: Harpers, 1947. Pp. x + 206. $3.00.

CISSEL, JAMES H. *Stress analysis and design of elementary structures.* (2nd ed.) New York: John Wiley; London: Chapman & Hall, 1948. Pp. xii + 419. (Illustrated.) $5.00.

DAVENPORT, HORACE W. *The ABC of acid-base chemistry.* Salt Lake City: Univ. Utah Bookstore, 1947. Pp. 85. (Illustrated.) $1.50.

FISCHER, ANTON. *Die philosophischen Grundlagen der wissenschaftlichen Erkenntnis.* Vienna, Austria: Springer-Verlag, 1947. Pp. vi + 240. $4.20.

GARARD, IRA D. *An introduction to organic chemistry.* (3rd ed.) New York: John Wiley; London: Chapman & Hall, 1948. Pp. xi + 396. $3.50.

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POUND, ROBERT V. (With a chapter by Eric Durand.) *Microwave mixers.* (Massachusetts Institute of Technology Radiation Laboratory Series.) (C. G. Montgomery and D. D. Montgomery, Eds.) New York-London: McGraw-Hill, 1948. Pp. xii + 381. (Illustrated.) $5.50.

RILEY, HERBERT PARKES. *Introduction to genetics and cytogenetics.* New York: John Wiley; London: Chapman & Hall, 1948. Pp. xii + 596. (Illustrated.) $5.00.

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THOMSON, SIR GEORGE. *The atom.* (3rd ed.) London-New York-Toronto: Oxford Univ. Press, 1948. Pp. v + 196. (Illustrated.) $2.00.

WATERMAN, ALLYN J. *A laboratory manual of comparative vertebrate embryology.* New York: Henry Holt, 1948. Pp. viii + 248. (Illustrated.) $3.50.

ZELIFF, C. COURSON. *Manual of medical parasitology; with techniques for laboratory diagnosis and notes on related animal parasites.* State College, Pa.: Keeler's College Stores, 1947. Pp. xiv + 159. (Illustrated.) $3.75.

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